THE KALMAN EARTH ORIENTATION FILTER

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An approach, based upon the use of a Kalman filter, that is currently employed at the Jet Propulsion Laboratory for combining independent measurements of the Earth's orientation is presented. Since changes in the Earth's orientation can be described as a randomly excited stochastic process, the uncertainty in our knowledge of the Earth's orientation grows rapidly in the absence of measurements. Consequently, it is important to analyze each measurement at its measurement epoch, rather than at some nearby, regularized epoch as is commonly done in normal-point methods of combining data sets. The Kalman filter methodology allows for an objective accounting of this uncertainty growth between measurements since it contains a model for the process, and in the absence of measurements uses this model to propagate forward in time the state vector and its covariance matrix to the measurement epoch regardless of whether or not the measurements are equi-spaced, thereby facilitating the combination of measurements taken at different epochs (not necessarily uniformly spaced in time) and with different precision. In addition, the use of a Kalman filter allows each measurement series to be processed in its own natural reference frame, whether it be the usual universal time-polar motion frame of GPS, SLR, and multibaseline VLBI measurements, the transverse-vertical-length frame of single baseline VLBI measurements, or the variation of latitude-UT0-degenerate frame of single station LLR measurements.